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## UTILITY PATENT APPLICATION TRANSMITTAL

(Only for new nonprovisional applications under 37 CFR 1.53(b))

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Mehmet Kemal Ozkan

<b>APPLICATION ELEMENTS</b> <small>See MPEP chapter 600 concerning utility patent application contents.</small>		<b>ADDRESS TO:</b> <small>Assistant Commissioner for Patents Box Patent Application Washington, DC 20231</small>	
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3. <input checked="" type="checkbox"/> Drawing(s) (35 USC 113) [Total Sheets 7]		<b>ACCOMPANYING APPLICATION PARTS</b>	
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Application for U.S. Letters Patent  
RCA 88,915

Sir:

Date: April 9, 1998

Enclosed herewith, are the following:

(1) Application for Letters Patent:

Applicant(s) Mehmet Kemal Ozkan, Chia-Yuan Teng and  
Edwin Arturo Heredia

For: A SYSTEM FOR FORMING AND PROCESSING PROGRAM MAP INFORMATION  
SUITABLE FOR TERRESTRIAL, CABLE OR SATELLITE BROADCAST

Date(s) Executed April 2, 1998, April 5, 1998 and March 18, 1998 respectively.

Number of sheets of drawing Seven (7)

(2) Assignment for the above-identified application.

(3) The required fees are calculated as follows.

Basic Filing Fee ..... \$790

Additional Fees:

Total number of claims, less 20 4 X \$22.00 = ..... 88

Number of independent claims, less 3 3 X \$82.00 = ..... 246

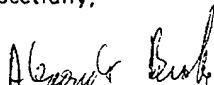
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5        A system for Forming and Processing Program Map  
Information Suitable for terrestrial, cable or satellite  
Broadcast

10      This is a non-provisional application of provisional  
application serial No. 60/052,152 by E. A. Heredia et al, filed July  
10, 1997.

*Field of the Invention*

15      This invention is related to the formation of Program  
Guides, system information and program specific information for  
MPEG compatible processing.

*Background of the Invention*

20      In video broadcast and processing applications, digital  
video data is typically encoded to conform to the requirements of  
a known standard. One such widely adopted standard is the  
25      MPEG2 (Moving Pictures Expert Group) image encoding standard,  
hereinafter referred to as the "MPEG standard". The MPEG  
standard is comprised of a system encoding section (ISO/IEC  
13818-1, 10th June 1994) and a video encoding section (ISO/IEC  
13818-2, 20th January 1995). Data encoded to the MPEG standard  
30      is in the form of a packetized datastream which typically includes  
the data content of many program channels (e.g. content  
corresponding to cable television channels 1-125). Further,  
several digital services and channels may occupy the frequency  
35      spectrum previously occupied by a single analog channel. A 6 MHz  
bandwidth previously allocated to an analog NTSC compatible  
broadcast channel may now be split into a number of digital sub-  
channels offering a variety of services. For example, the broadcast  
spectrum for RF channel 13 may be allocated to sub-channels  
40      including a main program channel, a financial service channel  
offering stock quotes, a sports news service channel and a  
shopping and interactive channel. In addition, both the quantity  
of sub-channels transmitted and the individual sub-channel

5 bandwidth may be changed dynamically to accommodate changing broadcast programming requirements.

In such a digital video system the proliferation in the quantity of services being broadcast and the increased variety of their content, as well as the ability of a broadcaster to 10 dynamically vary the number and allocated bandwidth of these channels poses a number of problems. Specifically, the increase in the quantity of broadcast channels may increase the difficulty of tuning and lengthen the time required to acquire a selected program channel. Further, as the quantity of channels increases so 15 does the quantity of ancillary program specific information required in decoding the transmitted program data. The ancillary program specific information includes data used in identifying and assembling packets comprising selected programs and also includes program guide and text information associated with the 20 transmitted program data. The increased quantity and variety of ancillary information transmitted places an additional burden on available transmission bandwidth and receiver decoding and storage resources.

In addition, channel numbering in such a digital video 25 system may present a problem. This is because a broadcaster may not want to lose an original analog NTSC broadcast channel number even though the broadcaster is transmitting several program channels in the frequency spectrum previously occupied by the single analog program channel. The broadcaster may have 30 a significant investment in the channel number as a brand identity e.g. Fox 5<sup>TM</sup>, Channel 13<sup>TM</sup>. These problems and derivative problems are addressed by a system according to the present invention.

35 *Summary of the Invention*

In a digital video system for decoding an MPEG compatible datastream containing MPEG compatible program map table information, channel map information is identified and 40 assembled. The channel map information identifies individual packetized datastreams that constitute a broadcast program. The

5 channel map information associates a broadcast channel with  
packet identifiers used to identify individual packetized  
datastreams that constitute a program transmitted in the  
broadcast channel. The channel map information replicates  
10 information conveyed in the MPEG compatible program map table  
information.

*Brief Description of the Drawings*

In the drawing:

15 Figure 1 is a block diagram of digital video receiving  
apparatus for demodulating and decoding broadcast signals,  
according to the principles of the invention.

20 Figure 2 shows a Master Guide Table (MGT) format for  
use in conveying program specific information, according to the  
invention.

25 Figure 3 shows a Channel Information Table (CIT)  
format for use in conveying program specific information  
incorporating dual program channel identification numbers,  
according to the invention.

30 Figure 4 shows a Service Location Descriptor (SLD)  
format for use in conveying program specific information  
incorporating program map information, according to the  
invention.

35 Figure 5 shows a program specific information text  
format for use in conveying program related text information,  
according to the invention.

Figure 6 shows a scheme for assigning a text message  
identifier as used in the text format of Figure 5.

5       Figure 7 shows a multiple compressed text string format for use in conveying program related text information, according to the invention.

10      Figures 8 and 9 show exemplary indicator definitions for compression and coding indicators within the multiple compressed text string format of Figure 7.

15      Figure 10 shows a method for generating program specific information according to the invention.

#### *Detailed Description of the Drawings*

20      Figure 1 is a block diagram of a digital video receiving system for demodulating and decoding broadcast signals, according to the principles of the invention. Although the disclosed system is described in the context of a system for receiving video signals incorporating program specific information including program guide data in MPEG compatible format, it is exemplary only. The program specific information may be of a variety of types. For example, it may comply with Program Specific Information (PSI) requirements specified in section 2.4.4 of the MPEG systems standard or it may comply with the high definition television (HDTV) signal standard *Digital Television Standard for HDTV Transmission* of April 12 1995, prepared by the United States Advanced Television Systems Committee (ATSC) or other ATSC standards. Alternatively, it may be formed in accordance with proprietary or custom requirements of a particular system.

35      The principles of the invention may be applied to terrestrial, cable, satellite, Internet or computer network broadcast systems in which the coding type or modulation format may be varied. Such systems may include, for example, non-MPEG compatible systems, involving other types of encoded datastreams and other methods of conveying program specific information. 40      Further, although the disclosed system is described as processing broadcast programs, this is exemplary only. The term 'program' is

5 used to represent any form of packetized data such as audio data, telephone messages, computer programs, Internet data or other communications, for example.

In overview, in the video receiver system of Figure 1, a broadcast carrier modulated with signals carrying audio, video and associated data representing broadcast program content is received by antenna 10 and processed by unit 13. The resultant digital output signal is demodulated by demodulator 15. The demodulated output from unit 15 is trellis decoded, mapped into byte length data segments, deinterleaved and Reed-Solomon error corrected by decoder 17. The corrected output data from unit 17 is in the form of an MPEG compatible transport datastream containing program representative multiplexed audio, video and data components. The transport stream from unit 17 is demultiplexed into audio, video and data components by unit 22 which are further processed by the other elements of decoder system 100. In one mode, decoder 100 provides MPEG decoded data for display and audio reproduction on units 50 and 55 respectively. In another mode, the transport stream from unit 17 is processed by decoder 100 to provide an MPEG compatible datastream for storage on storage medium 105 via storage device 90.

A user selects for viewing either a TV channel or an on-screen menu, such as a program guide, by using a remote control unit 70. Processor 60 uses the selection information provided from remote control unit 70 via interface 65 to appropriately configure the elements of Figure 1 to receive a desired program channel for viewing. Processor 60 comprises processor 62 and controller 64. Unit 62 processes (i.e. parses, collates and assembles) program specific information including program guide and system information and controller 64 performs the remaining control functions required in operating decoder 100. Although the functions of unit 60 may be implemented as separate elements 62 and 64 as depicted in Figure 1, they may alternatively be implemented within a single processor. For example, the functions of units 62 and 64 may be incorporated within the programmed instructions of a

5 microprocessor. Processor 60 configures processor 13, demodulator 15, decoder 17 and decoder system 100 to demodulate and decode the input signal format and coding type. Units 13, 15, 17 and sub-units within decoder 100 are individually configured for the input signal type by processor 60 10 setting control register values within these elements using a bi-directional data and control signal bus C.

15 The transport stream provided to decoder 100 comprises data packets containing program channel data and program specific information. Unit 22 directs the program specific information packets to processor 60 which parses, collates and assembles this information into hierarchically arranged tables. Individual data packets comprising the User selected program channel are identified and assembled using the assembled 20 program specific information. The program specific information contains conditional access, network information and identification and linking data enabling the system of Figure 1 to tune to a desired channel and assemble data packets to form complete programs. The program specific information also contains ancillary program guide information (e.g. an Electronic Program Guide - 25 EPG) and descriptive text related to the broadcast programs as well as data supporting the identification and assembly of this ancillary information.

30 The program specific information is assembled by processor 60 into multiple hierarchically arranged and inter-linked tables. An exemplary hierarchical table arrangement includes a Master Guide Table (MGT), a Channel Information Table (CIT), Event Information Tables (EITs) and optional tables such as Extended Text Tables (ETTs). The MGT contains information for 35 acquiring program specific information conveyed in other tables such as identifiers for identifying data packets associated with the other tables. The CIT contains information for tuning and navigation to receive a User selected program channel. The EIT contains descriptive lists of programs (events) receivable on the channels listed in the CIT. The ETT contains text messages 40 describing programs and program channels. Additional program specific information describing and supplementing items within

5 the hierarchical tables is conveyed within descriptor information elements. The program specific information acquired by processor 60 via unit 22 is stored within internal memory of unit 60.

10 Considering Figure 1 in detail, a carrier modulated with signals carrying program representative audio, video and associated data received by antenna 10, is converted to digital form and processed by input processor 13. Processor 13 includes radio frequency (RF) tuner and intermediate frequency (IF) mixer and amplification stages for down-converting the input signal to a lower frequency band suitable for further processing. In this exemplary system, the input signal received by antenna 10 contains 33 Physical Transmission Channels (PTCs 0-32). Each Physical Transmission Channel (PTC) is allocated a 6 MHz bandwidth and contains, for example, up to 6 sub-channels.

15 It is assumed for exemplary purposes that a video receiver user selects a sub-channel (SC) for viewing using remote control unit 70. Processor 60 uses the selection information provided from remote control unit 70 via interface 65 to appropriately configure the elements of decoder 100 to receive the PTC corresponding to the selected sub-channel SC. Following down conversion, the output signal from unit 13 for the selected PTC has a bandwidth of 6 MHz and a center frequency in the range of 119-405 MHz. In the following discussion, an RF channel or Physical Transmission Channel (PTC) refers to an allocated broadcaster transmission channel band which encompasses one or 20 more sub-channels (also termed virtual or logical channels).

25 Processor 60 configures the radio frequency (RF) tuner and intermediate frequency (IF) mixer and amplification stages of unit 13 to receive the selected PTC. The down-converted frequency output for the selected PTC is demodulated by unit 15. The primary functions of demodulator 15 are recovery and tracking of the carrier frequency, recovery of the transmitted data 30 clock frequency, and recovery of the video data itself. Unit 15 also recovers sampling and synchronization clocks that correspond to transmitter clocks and are used for timing the operation of processor 13, demodulator 15 and decoder 17. The recovered 35 output from unit 15 is provided to decoder 17.

5           The output from demodulator 15 is mapped into byte  
length data segments, deinterleaved and Reed-Solomon error  
corrected according to known principles by unit 17. In addition,  
10          unit 17 provides a Forward Error Correction (FEC) validity or lock  
indication to processor 60. Reed-Solomon error correction is a  
known type of Forward Error Correction. The FEC lock indication  
15          signals that the Reed-Solomon error correction is synchronized to  
the data being corrected and is providing a valid output. It is to be  
noted that the demodulator and decoder functions implemented  
by units 13, 15 and 17 are individually known and generally  
15          described, for example, in the reference text *Digital  
Communication*, Lee and Messerschmidt (Kluwer Academic Press,  
Boston, MA, USA, 1988).

20          The corrected output data from unit 17 is processed  
by MPEG compatible transport processor and demultiplexer 22.  
The individual packets that comprise either particular program  
channel content, or program specific information, are identified by  
their Packet Identifiers (PIPs). Processor 22 separates data  
according to type based on an analysis of Packet Identifiers (PIPs)  
25          contained within packet header information and provides  
synchronization and error indication information used in  
subsequent video, audio and data decompression.

30          The corrected output data provided to processor 22 is  
in the form of a transport datastream containing program channel  
content and program specific information for many programs  
distributed through several sub-channels. The program specific  
information in this exemplary description describes sub-channels  
35          present in a transport stream of a particular PTC. However, in  
another embodiment the program specific information may also  
describe sub-channels located in other PTCs and conveyed in  
different transport streams. Groups of these sub-channels may be  
40          associated in that their source is a particular broadcaster or they  
occupy the transmission bandwidth previously allocated to an  
analog NTSC compatible broadcast channel. Further, individual  
packets that comprise a selected program channel in the transport  
stream are identified and assembled by processor 60 operating in

5 conjunction with processor 22 using PIDs contained in the program specific information.

The program specific information is in the form of hierarchically arranged tables including an MGT, CIT, EIT, and ETT together with supplementary descriptor information. The PID that identifies packets comprising the MGT data is predetermined and stored within processor 60 internal memory. Further, the MGT conveys the PIDs that identify the CIT, EIT, and ETT data and conveys other information indicating the size of these tables. Processor 60 monitors the MGT for updates to identify any changes in PIDs or table sizes. Therefore, after processor 60 determines from the FEC lock indication provided by unit 17 that valid data is being provided to transport processor 22, the MGT may be acquired without additional PID information. Using Control signal C, processor 60 configures transport processor 22 to select the data packets comprising the remaining program specific information including the CIT, EIT and ETT data. Processor 22 matches the PIDs of incoming packets provided by unit 17 with PID values pre-loaded in control registers within unit 22 by processor 60. Further, processor 60 accesses, parses and assembles the program specific information packets captured by processor 22 and stores the program specific information within its internal memory. Processor 60 derives tuning parameters including PTC carrier frequency, demodulation characteristics, and sub-channel PIDs, from the acquired program specific information. Processor 60 uses this information in configuring units 13, 15, 17 and decoder 100 elements to acquire selected sub-channel (SC) program content.

The program specific information including MGT, CIT, EIT, and ETT data and associated descriptors acquired and collated by processor 60 incorporates advantageous features exemplified in the data formats presented in Figures 2-9. These features facilitate the identification, acquisition, assembly and decoding of program channel content and associated program guide data by decoder 100 (Figure 1). Processor 60 forms a MGT as exemplified by the data format of Figure 2 by accessing and assembling the program specific information packets that are stored in the unit

5 60 internal memory. The MGT contains data identifiers e.g. PID\_ETT 205 and PID\_PG 210 (Figure 2) enabling the assembly of the CIT, EIT and ETT tables. Processor 60 uses the MGT data identifiers to access and assemble the program specific information packets to form the CIT, EIT, and ETT data and  
10 associated descriptors.

Processor 60 uses the acquired CIT channel map information, as exemplified in Figure 3, to identify the packets comprising the sub-channel SC that the User selected to view. A user selects sub-channel SC for viewing by entering two program channel numbers via remote control unit 70 and interface 65. Individual program channels are advantageously allocated both a first and a second identification number. The first identification number (a major number as indicated by bundle\_number 300 in Figure 3) identifies the broadcast source and broadcaster channel brand number e.g. Fox 5<sup>TM</sup>, Channel 13<sup>TM</sup>. The first identification number indicates a broadcast source of a program or service and may be independent of the RF channel on which the program is broadcast. However, in other embodiments the first identification number may be associated with a broadcast RF channel or be associated with other program characteristics such as a program category or theme e.g. movies. The second identification number (a minor number as indicated by channel\_number\_in\_bundle 305 in Figure 3) identifies a sub-channel corresponding to a specific service within a group of services provided by a broadcaster. The first and second identification numbers in conjunction identify a particular service as a sub-channel provided by a specific broadcaster. Although, the selected sub-channel SC may occupy an RF bandwidth within an encompassing channel spectrum associated with the broadcast source, neither the first or second identification numbers are associated with such a spectrum. However, this association may be made in an alternative embodiment. This dual numbering system enables a broadcaster to retain channel brand identity across a range of dynamically allocable broadcast sub-channels.

40 The dual program channel identification numbers used to select sub-channel SC may be entered by the user in a variety

5 of ways. These may include using remote unit 70 to select sub-channel SC from within a hierarchical menu system displaying program channel selections in a program guide or by simple sequential number entry via the unit 70 keypad, for example. The channel selection system may also encompass the use of a  
10 different data entry device such as a keyboard or discrete switches, for example. Further, the data entry system also accommodates the entry of a single channel identification number as well as dual identification numbers. Upon detecting a channel selection completion command, processor 60 converts a single  
15 channel identification number entry into dual identification numbers. Processor 60 converts the single channel identification number to dual channel identification numbers in accordance with a predetermined conversion map. This conversion may also be performed using a predetermined and stored algorithm or formula.  
20 The derived dual identification numbers are used by processor 60 for packet identification, tuning and for identifying other decoder information in the manner previously described as if both numbers had been entered by a user.

Processor 60 uses the received program channel identification numbers 300 and 305 provided from remote control unit 70 via interface 65 to determine the PTC corresponding to the selected sub-channel SC from the CIT. Once the PTC number (item 315 in Figure 3) is determined, processor 60 (Figure 1) configures units 13, 15, and 17 to receive the PTC for the selected sub-channel SC. The unique program sub-channel determined from the program channel identification numbers 300 and 305 may alternatively be termed a service or a virtual channel or a logical channel and the CIT may be deemed a virtual channel table. Further, as well as associating a particular PTC with first and second sub-channel identification numbers 300 and 305 of selected sub-channel SC, the CIT also associates other parameters with SC. These parameters include (a) a channel\_id 320 for linking the selected sub-channel SC with program content information conveyed in the EITs, (b) a channel\_type indicator 325 identifying whether the sub-channel data is, analog e.g. NTSC, digital video e.g. ATSC video or digital audio e.g. ATSC audio, (c) an ETM\_flag  
30  
35  
40

5 330 indicating whether a text message is available for this sub-channel, (d) a channel name 340 and (e) a descriptor 335 e.g. a Service Location Descriptor as described later.

10 Processor 60 advantageously determines program map information for the selected sub-channel SC from Service Location Descriptor (SLD) conveyed within the CIT. The SLD program map information is exemplified by the data format of Figure 4. The SLD associates the selected sub-channel SC with packet identifiers, e.g. item 420, used to identify individual packetized datastreams that constitute the components of a program being transmitted on selected sub-channel SC. In addition, the SLD program map information, in conjunction with the CIT, maps the selected sub-channel SC to a program number 405, a PCR (Program Clock Reference) identifier 410, a language code indicator 425, and a stream type identifier 415 identifying a stream as video, audio, control, auxiliary or private information, for example.

15 The SLD program map information replicates information already present within the Program Map Table (PMT) segment of the MPEG compatible transport stream input to decoder 100. However, by incorporating the SLD within the CIT, the time required by decoder 100 to identify and acquire a program being transmitted on selected sub-channel SC is advantageously reduced. This is because the CIT and SLD provide formatted and linked information sufficient to enable processor 60 to directly configure and tune the system of Figure 1 to receive the selected sub-channel SC. Specifically, the CIT and SLD directly associate individual first and second sub-channel identification numbers with the PIDs for identifying the datastreams that constitute a program being conveyed on this sub-channel. This enables processor 60 to configure the system of Figure 1 to receive the selected sub-channel SC without acquiring and using the Program Map Table (PMT) information in the MPEG compatible transport stream input to decoder 100. In addition, the data partitioning, data formatting and data repetition frequency characteristics of the CIT and SLD program map information may 20 be determined independently of the requirements of MPEG PMT information.

5           The packetized decoded transport stream input to decoder 100 from unit 17 contains video, audio and data representing TV programs, for example, and also contains sub-picture data. The sub-picture data contains picture elements associated with programs and channels selectable by a user for viewing including program guides, display commands, subtitling, selectable menu options or other items, for example. As such, the sub-picture data includes the EIT containing descriptive lists of programs (events) receivable on the sub-channels listed in the CIT and also contains the ETT containing text messages describing programs and program sub-channels.

Processor 60 determines from the CIT and SLD the PIDs of the video, audio and sub-picture streams constituting the program being transmitted on selected sub-channel SC. Processor 22, matches the PIDs of incoming packets provided by decoder 17 with PID values of the video, audio and sub-picture streams being transmitted on sub-channel SC. These PID values are pre-loaded in control registers within unit 22 by processor 60. In this manner, processor 22 captures packets constituting the program transmitted on sub-channel SC and forms them into MPEG compatible video, audio and sub-picture streams for output to video decoder 25, audio decoder 35 and sub-picture processor 30 respectively. The video and audio streams contain compressed video and audio data representing the selected sub-channel SC program content. The sub-picture data contains the EIT and ETT information associated with the sub-channel SC program content.

Decoder 25 decodes and decompresses the MPEG compatible packetized video data from unit 22 and provides decompressed program representative pixel data to NTSC encoder 45 via multiplexer 40. Similarly, audio processor 35 decodes the packetized audio data from unit 22 and provides decoded and amplified audio data, synchronized with the associated decompressed video data, to device 55 for audio reproduction. Processor 30 decodes and decompresses sub-picture data received from unit 22.

The sub-picture data decoded by processor 30 includes text messages (Extended Text Messages - ETMs) in an ETT

5 in the exemplary data format presented in Figure 5. The text  
messages conveyed in the ETT of Figure 5 are advantageously  
partitioned into time periods of specified duration. The segmented  
text messages describe programs occurring in a period of specified  
duration and start time e.g. 3 hour blocks starting from 12 a.m., 3  
10 p.m., 6 p.m.... etc. Indicators defining the duration and start time  
applicable to the conveyed text messages are included in the MGT  
of Figure 2 (duration item 215 and application\_time item 220 of  
Figure 2 respectively). A text message (e.g.  
15 extended\_text\_message 505) is conveyed together with a text  
message identifier (ETM\_id 510) in the format of Figure 5.

Decoder 100 (Figure 1) is able to more efficiently  
acquire, process and store program descriptive text messages that  
are partitioned into time periods of specified duration than is  
possible in the absence of such segmentation. This is because  
20 segmented text messages exclude information occurring outside  
the specified time period and consequently are smaller than non-  
segmented text messages. Therefore, segmented text message data  
occupies less storage space and can be acquired and processed  
more quickly than larger data blocks of non-segmented data.  
25 Further, the data format of Figure 5 allows a user to acquire text  
message data for a selected sub-channel SC or a group of selected  
program sub-channels. This allows the identification, acquisition  
and decoding of text message data by decoder 100 to be focused  
30 on the programs and sub-channels of interest to a user and  
reduces the acquisition of redundant text message information.

A text message conveyed in an ETT may contain  
channel information or program (event) information. Figure 6  
shows an exemplary format for assigning a text message identifier  
35 ETM\_id 510 of Figure 5 that identifies the type of text message  
e.g. whether the text message contains channel information (item  
610 of Figure 6) or program information (item 605 of Figure 6).  
The text message identifier 510 (Figure 5) also identifies the  
source e.g. sub-channel to which the text message pertains.

40 A text message 505 conveyed in the ETT of Figure 5 is  
compressed and formatted according to the multiple compressed  
text string format of Figure 7. The compressed text string format

5 advantageously incorporates indicators facilitating the identification and decoding of multiple compressed text strings by processor 30 in decoder 100 of Figure 1. Processor 30 decodes text string 505 (Figure 5) received from unit 22 (Figure 1) by determining the compression, coding and language characteristics  
10 of the text string from indicators 705, 710 and 715 (Figure 7) respectively. Specifically, processor 30, operating in conjunction with processor 60, decompresses received text string 505 by applying a decompression function e.g. a Huffman decompression function, selected using indicator 705. Similarly, processor 30,  
15 decodes the received text string by applying a decoding function interpreting text characters according to a character code set selected using indicator 710 and a language code set selected using indicator 715. Further, processor 30 determines the number of text strings to be processed and the number of bytes in each  
20 text string from indicators 725 and 720 respectively.

Figure 8 shows an exemplary indicator definition for compression indicator 705 within the multiple compressed text string format of Figure 7. It is to be noted that compression indicator 705 may indicate that no compression function is employed within a text string. In this case, processor 30 does not apply a decompression function to the text string received from unit 22. Figure 9 shows an exemplary indicator definition for coding indicator 710 within the multiple compressed text string format of Figure 7.

30 Processor 30 assembles and formats the decoded and decompressed text string elements of text string 505 (Figure 5) to form a decoded text string for output to On-Screen Display (OSD) and graphics generator 37 (Figure 1). Unit 37 interprets and formats the text string character data from unit 30 and generates  
35 formatted pixel mapped text and graphics for presentation on unit 50. The formatted pixel mapped text and graphics data may represent a program guide or other type of menu or user interface for subsequent display on unit 50. Unit 37 also processes EIT, ETT and other information to generate pixel mapped data representing, subtitling, control and information menu displays including selectable menu options, and other items, for  
40

5 presentation on unit 50. The control and information displays enable function selection and entry of device operating parameters for User operation of decoder 100.

10 The text and graphics produced by OSD generator 37 are generated in the form of overlay pixel map data under direction of processor 60. The overlay pixel map data from unit 37 is combined and synchronized with the decompressed pixel representative data from MPEG decoder 25 in encoder 45 via multiplexer 40 under direction of processor 60. Combined pixel map data representing a video program on sub-channel SC 15 together with associated sub-picture text message data is encoded by NTSC encoder 45 and output to device 50 for display.

20 In a storage mode of the system of Figure 1, the corrected output data from unit 17 is processed by decoder 100 to provide an MPEG compatible datastream for storage. In this mode, a program is selected for storage by a user via remote unit 70 and interface 65. Processor 22, in conjunction with processor 60 forms condensed program specific information including MGT, CIT, EIT and ETT data and descriptors containing the advantageous features previously described. The condensed program specific 25 information supports decoding of the program selected for storage but excludes unrelated information. Processor 60, in conjunction with processor 22 forms a composite MPEG compatible datastream containing packetized content data of the selected program and associated condensed program specific information. The composite 30 datastream is output to storage interface 95.

35 Storage interface 95 buffers the composite datastream to reduce gaps and bit rate variation in the data. The resultant buffered data is processed by storage device 90 to be suitable for storage on medium 105. Storage device 90 encodes the buffered datastream from interface 95 using known error encoding techniques such as channel coding, interleaving and Reed Solomon encoding to produce an encoded datastream suitable for storage. Unit 90 stores the resultant encoded datastream incorporating the condensed program specific information on medium 105.

40 Figure 10 shows a method for generating program specific information including MGT, CIT, EIT and ETT data and

5 descriptors containing the advantageous features previously described. The method may be employed at an encoder for broadcasting video data such as the data received by antenna 10 of Figure 1 or the method may be employed within a decoder unit such as within processor 60 of Figure 1.

10 Following the start at step 800 of Figure 10, a CIT is generated in step 810. The CIT contains sub-channel and program identification information enabling acquisition of available broadcast programs and sub-channels. The CIT incorporates first and second sub-channel identification numbers and an SLD 15 containing packet identifiers for identifying individual packetized datastreams that constitute individual programs to be transmitted on particular sub-channels. The generated CIT also incorporates items linked to listed program sub-channels including a program number, a PCR (Program Clock Reference) identifier, a language code indicator, and a stream type identifier, as previously 20 described in connection with Figure 1.

25 In step 815, an EIT is generated containing program guide information including descriptive lists of programs (events) receivable on the sub-channels listed in the CIT. In step 820, an ETT is generated containing text messages describing programs, for example. Each text message is partitioned into time periods of specified duration. The duration and application time of the segmented text message data is also defined by indicators in the ETT itself. The text message data is encoded and compressed 30 according to known techniques and conveyed in the ETT along with indicators defining the compression, coding and language characteristics employed. The ETT is also generated to include indicators defining the number of text strings to be processed and the number of bytes in each text string. In step 822 an MGT is 35 generated containing data identifiers enabling the identification and assembly of CIT, EIT and ETT information. The MGT also conveys table size information for the previously generated CIT, EIT and ETT.

40 In step 825, program specific information is formed including the MGT, CIT, EIT and ETT data and descriptors generated in steps 805-822. In step 830, the program specific

5 information together with video and audio program representative components for multiple sub-channels is formatted into a transport stream for output. In step 835, the output transport stream is further processed to be suitable for transmission to another device such as a receiver, video server, or storage device for recording on a storage medium, for example. The processes performed in step 835 include known encoding functions such as data compression Reed-Solomon encoding, interleaving, scrambling, trellis encoding, and carrier modulation. The process is complete and terminates at step 840. In the process 10 of Figure 10, multiple CIT, EIT and ETT tables may be formed and incorporated in the program specific information in order to accommodate expanded numbers of sub-channels.

15 The architecture of Figure 1 is not exclusive. Other architectures may be derived in accordance with the principles of the invention to accomplish the same objectives. Further, the functions of the elements of decoder 100 of Figure 1 and the process steps of Figure 10 may be implemented in whole or in part within the programmed instructions of a microprocessor. In addition, the principles of the invention apply to any form of 20 MPEG or non-MPEG compatible electronic program guide. A datastream formed according to the invention principles may be used in a variety of applications including video server or PC type communication via telephone lines, for example. A program datastream with one or more components of video, audio and data 25 formed to incorporate program specific information according to invention principles may be recorded on a storage medium and transmitted or re-broadcast to other servers, PCs or receivers. Further, any reference herein to "bandwidth" is to be interpreted 30 expansively to include bit rate capacity and is not limited to a frequency spectrum, for example.

5 What is claimed is:

1. Apparatus for decoding a datastream of MPEG compatible packetized program information containing program map table information to provide decoded program data, comprising:

means for identifying channel map information conveyed within said packetized program information, said channel map information associating a broadcast channel with packet identifiers used to identify individual packetized datastreams that constitute a program transmitted in said broadcast channel; and

means for assembling said identified information to form a channel map for identifying said individual packetized datastreams constituting said program, wherein

20 said channel map information replicates information conveyed in said MPEG compatible program map table information.

25 2. Apparatus according to claim 1, wherein

25 said channel map information further associates an individual program with a corresponding program clock reference (PCR) value.

30 3. Apparatus according to claim 1, wherein

30 said channel map information further associates an individual program with a corresponding language type indicator.

35 4. Apparatus according to claim 1, wherein

35 said channel map information further associates an individual program with a corresponding physical transmission channel carrier frequency.

40 5. Apparatus according to claim 1, including

40 means for tuning to receive said program transmitted on said broadcast channel using said channel map information for acquisition of said program.

5

6. Apparatus according to claim 1, wherein  
said channel map information further associates said  
packet identifiers with first and second identification numbers  
used in conjunction to identify said broadcast channel.

10

7. Apparatus according to claim 6, wherein  
said decoder acquires said program transmitted on  
said broadcast channel in response to User entry of said first and  
second identification numbers.

15

8. Apparatus according to claim 1, wherein  
said information associating said broadcast channel  
with said packet identifiers is conveyed within a descriptor  
section of said channel map information.

20

9. Apparatus according to claim 8, wherein  
said channel map information associates a plurality of  
broadcast channels with corresponding descriptor sections.

25

10. Apparatus according to claim 1, wherein  
said channel map information further associates a  
datastream type indicator with an individual packetized  
datastream, said datastream type indicator identifying whether  
said individual packetized datastream contains at least one of a)  
30 audio information, and b) video information.

5           11. Apparatus for decoding MPEG compatible  
packetized program information to provide decoded program data,  
comprising:

10           means for identifying channel map information  
conveyed within said packetized program information, said  
channel map information associating a broadcast channel with  
packet identifiers used to identify individual packetized  
datastreams that constitute a program transmitted in said  
broadcast channel; and

15           means for assembling said identified information to  
form a channel map for identifying said individual packetized  
datastreams constituting said program, wherein

              said channel map information associates an  
individual program with a corresponding language type indicator.

20           12. Apparatus according to claim 11, wherein  
said channel map information associates an individual  
program with a corresponding program clock reference (PCR)  
value.

25           13. A storage medium containing MPEG compatible  
digital data representing video information comprising:

              a video program;  
              MPEG compatible program map table information; and  
              channel map information contained within said MPEG  
30           compatible digital data, said channel map information associating  
packet identifiers with individual packetized datastreams that  
constitute said video program, wherein

              said channel map information replicates  
information conveyed in said MPEG compatible program map  
35           table information.

              14. A storage medium according to claim 13, wherein  
said channel map information further associates an  
individual program with a corresponding language type indicator.

5 15. A storage medium according to claim 13, wherein  
said channel map information further associates an  
individual program with a corresponding program clock reference  
(PCR) value.

10 16. Apparatus for forming program guide information  
suitable for decoding MPEG compatible packetized program  
information containing program map table information to provide  
decoded program data, comprising:  
15 means for forming channel map information including  
information associating a broadcast channel with packet  
identifiers used to identify individual packetized datastreams that  
constitute a program transmitted in said broadcast channel; and  
means for incorporating said channel map information into  
packetized program guide information for output, wherein  
20 said channel map information replicates  
information conveyed in said MPEG compatible program map  
table information.

25 17. Apparatus according to claim 16, wherein  
said channel map information further associates an  
individual program with a corresponding program clock reference  
(PCR) value.

30 18. Apparatus according to claim 16, wherein  
said channel map information further associates an  
individual program with a corresponding language type indicator.

35 19. Apparatus according to claim 16, wherein  
said channel map information further associates said  
packet identifiers with first and second identification numbers  
used in conjunction to identify said broadcast channel.

40 20. Apparatus according to claim 16, wherein  
said information associating said broadcast channel  
with said packet identifiers is conveyed within a descriptor  
section of said channel map information.

21. Apparatus according to claim 20, wherein  
said channel map information associates a plurality of  
broadcast channels with corresponding descriptor sections.

10 22. Apparatus according to claim 16, wherein  
said channel map information further associates a  
datastream type indicator with an individual packetized  
datastream, said datastream type indicator identifying whether  
said individual packetized datastream contains at least one of a)  
15 audio information, and b) video information.

20 23. A method for decoding MPEG compatible  
packetized program information containing program map table  
information to provide decoded program data, comprising the  
steps of:

25 identifying channel map information conveyed within  
said packetized program information, said channel map  
information associating a broadcast channel with packet  
identifiers used to identify individual packetized datastreams that  
constitute a program transmitted on said broadcast channel; and  
assembling said identified information to form a  
channel map suitable for use in identifying said individual  
packetized datastreams constituting said program, wherein  
30 said channel map information replicates  
information conveyed in said MPEG compatible program map  
table information.

5           24. A method for forming program guide information suitable for decoding MPEG compatible packetized program information containing program map table information to provide decoded program data, comprising the steps of:

10           forming channel map information including information associating a broadcast channel with packet identifiers used to identify individual packetized datastreams that constitute a program transmitted on said broadcast channel; and

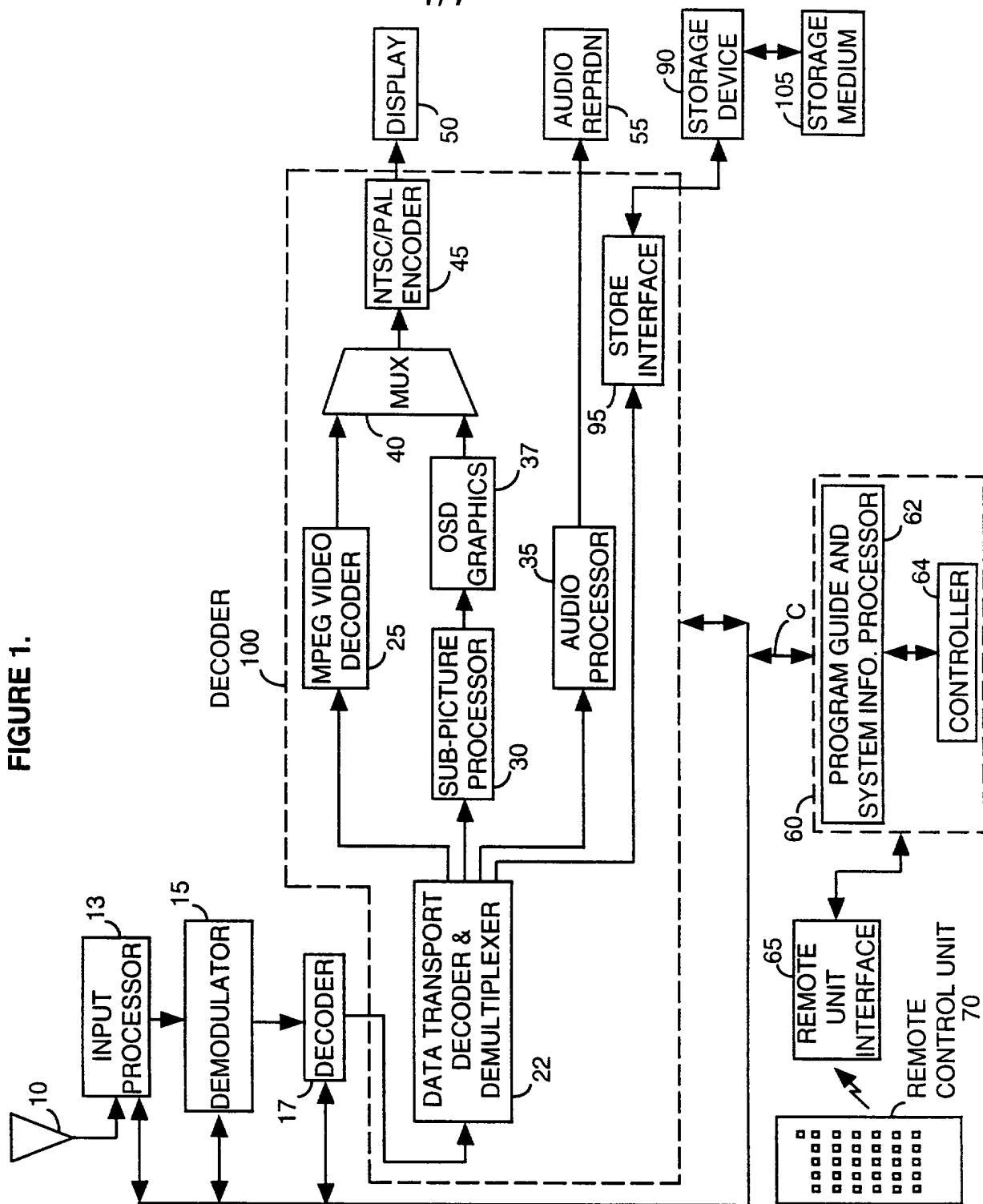
15           incorporating said channel map information into packetized program guide information for output, wherein

15           said channel map information replicates information conveyed in said MPEG compatible program map table information.

*Abstract*

Channel map information includes program map table information in packetized program information used in video processing and storage medium formats. In a digital video system for decoding an MPEG compatible datastream containing MPEG compatible program map table information, channel map information is identified and assembled. The channel map information identifies individual packetized datastreams that constitute a broadcast program. The channel map information associates a broadcast channel with packet identifiers used to identify individual packetized datastreams that constitute a program transmitted in the broadcast channel. The channel map information replicates information conveyed in the MPEG compatible program map table information.

FIGURE 1.



## Bit Stream Syntax for the Master Guide Table

Syntax	Bits	Format
master_guide_table_section () {		
table_id	8	0xE0
section_syntax_indicator	1	'1'
private_indicator	1	'1'
reserved	2	'11'
private_section_length	12	uimsbf
table_id_extension	16	0x0000
reserved	2	'11'
version_number	5	uimsbf
current_next_indicator	1	'1'
section_number	8	0x00
last_section_number	8	0x00
reserved	3	'111'
CRT_version_number	5	uimsbf
zero	4	'0000'
num_pg	4	uimsbf
for (i=0;i< num_pg;i++) PG(i) {		
application_time	40	uimsbf
duration	16	uimsbf
reserved	2	'11'
CIT_flag	1	blsbf
num_bytes	21	uimsbf
reserved	3	'111'
PID_PG [i]	13	uimsbf
reserved	3	'111'
PID_ETT [i]	13	uimsbf
reserved	4	uimsbf
PG_descriptors_length	12	uimsbf
for(j = 0;i< M;j++)		
descriptor ()	var	
}		
reserved	4	uimsbf
descriptors_length	12	uimsbf
for (i = 0;i< N;j++)		
descriptor ()	var	
CRC_32	32	rpchof

FIGURE 2

## Bit Stream Syntax for the Channel Information Table

Syntax	Bits	Format
channel_guide_table_section () {		
table_id	8	0xE3
section_syntax_indicator	1	'1'
private_indicator	1	'1'
reserved	2	'11'
section_length	12	uimsbf
table_id_extension	16	uimsbf
reserved	2	'11'
version_number	5	uimsbf
current_next_indicator	1	'1'
section_number	8	uimsbf
last_section_number	8	uimsbf
num_channels_in_section	8	uimsbf
for (k=0; k<num_channels_in_section;k++) cha_info(k){		
short_name	8*6	ISO-639
channel_visibility	32	bslbf
bundle_channel_number{		
bundle_number	12	uimsbf
channel_number_in_bundle	12	uimsbf
}		
Channel_PTC	8	uimsbf
channel_id	16	uimsbf
channel_type	8	uimsbf
reserved	3	'111'
ETM_flag	1	bslbf
descriptors_length	12	uimsbf
for (i=0;i<N;i++){		
descriptors()		
}		
}		
CRC_32	32	rpchof
}		

FIGURE 3

### Bit Stream Syntax for the Service Location Descriptor

	Syntax	Bits	Format
405	service_location_descriptor () {		
	descriptor_tag	8	uimsbf
	descriptor_length	8	uimsbf
410	program_number	16	uimsbf
	reserved	3	'111'
	PCR_PID	13	uimsbf
	number_PIDs	8	uimsbf
415	for (i=1;i<number_PIDs;i++){		
	stream_type	8	uimsbf
420	reserved	3	bslbf
	elementary_PID	13	uimsbf
	ISO_639_language_code	8*3	uimsbf
425	}		

FIGURE 4

## Bit Stream Syntax for the Service Location Descriptor

Syntax	Bits	Format
extended_text_table_section () {		
table_id	8	0xE5
section_syntax_indicator	1	'0'
private_indicator	1	'1'
reserved	2	'11'
510    private_section_length	12	uimsbf
ETM_id	32	bslbf
505    extended_text_message ()	var	
}		

FIGURE 5

Bit	1	2	3	18	19	32
610    channel ETM_id	0	0		channel_id	111.....	111
605    event ETM_id	1	0		channel_id		event_id

FIGURE 6

## Bit Stream Syntax for the Service Location Descriptor

Syntax	Bits	Format
multiple_compressed_strings () {		
<b>number_strings</b>	8	uimsbf
for (i = 0;i< number_strings;i++) {		
<b>number_bytes</b>	16	uimsbf
<b>ISO_639_language_code</b>	8*3	uimsbf
<b>coding_indicator</b>	8	bslbf
<b>compression_type</b>	8	uimsbf
for (j = 0;j<number_bytes;j++)		
<b>compressed_string_type [j]</b>	8	uimsbf
}		
}		

FIGURE 7

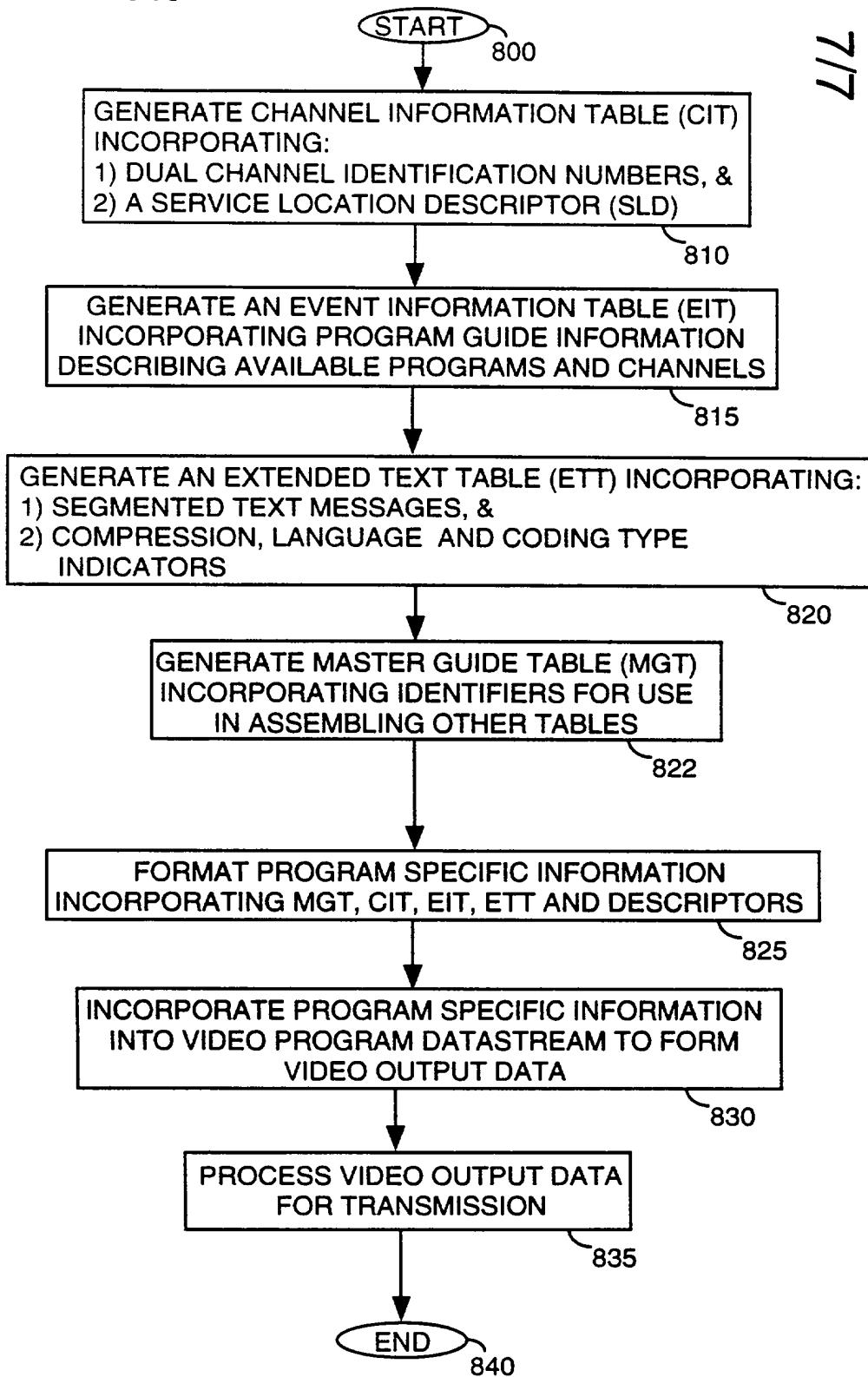
compression_type	compression method
0x00	No compression
0x01	Huffman coding based on the default Huffman table
0x02	LZW
0x03 to 0xAF	reserved
0xB0 to 0xFF	user private

FIGURE 8

coding_indicator	coding method
0x00	Unicode
0x01	Latin-1
0x02	Latin-2
0x03 to 0xAF	reserved
0xB0 to 0xFF	user private

FIGURE 9

**FIGURE 10**



## DECLARATION AND POWERS OF ATTORNEY

As a below named inventor, I hereby declare that:

My residence, post office address and citizenship are as stated below next to my name.

I believe I am the original, first and sole inventor (if only one name is listed below) or an original, first and joint inventor (if plural names are listed below) of the subject matter which is claimed and for which a patent is sought on the invention entitled **A SYSTEM FOR FORMING AND PROCESSING PROGRAM MAP INFORMATION SUITABLE FOR TERRESTRIAL, CABLE OR SATELLITE BROADCAST**

the specification of which was filed on \_\_\_\_\_ as Application Serial No. \_\_\_\_\_ and was amended on \_\_\_\_\_, or, if not identified here by filing date and serial number, is attached hereto.

I have reviewed and understand the contents of the above identified specification, including the claims, as amended by any amendment referred to above.

I acknowledge the duty to disclose information which is material to the examination of this application in accordance with 37 CFR 1.56.

I hereby claim foreign priority benefits under 35 USC 119 of any foreign application(s) for patent or inventor's certificate listed below and have also identified below any foreign application for patent or inventor's certificate by me or my representatives or assigns for this invention having a filing date before that of the application on which priority is claimed.

Application No. \_\_\_\_\_ in \_\_\_\_\_ on \_\_\_\_\_ priority claimed [ ] Yes [ ] No

Application No. \_\_\_\_\_ in \_\_\_\_\_ on \_\_\_\_\_ priority claimed [ ] Yes [ ] No

Application No. \_\_\_\_\_ in \_\_\_\_\_ on \_\_\_\_\_ priority claimed [ ] Yes [ ] No

I hereby claim the benefit under 35 USC 119(e) of any United States provisional application(s) as listed below.

Application No. 60/052,152 Filed 07/10/97

Application No. \_\_\_\_\_ Filed \_\_\_\_\_

I hereby claim the benefit under 35 USC 120 of any United States application(s) listed below and, insofar as the subject matter of each of the claims of this application is not disclosed in the prior United States application in the manner provided by the first paragraph of 35 USC 112, I acknowledge the duty to disclose material information as defined in 37 CFR 1.56(a) which occurred between the filing date of the prior application and the national or PCT international filing date of this application

Serial No. \_\_\_\_\_ Filed \_\_\_\_\_ [ ] patented [ ] pending [ ] abandoned

Serial No. \_\_\_\_\_ Filed \_\_\_\_\_ [ ] patented [ ] pending [ ] abandoned

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under 18 USC 1001 and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

I hereby appoint, individually and collectively, the following as my/our attorney or agent with full power of substitution and revocation, to prosecute this application and to transact all business in the U.S. Patent and Trademark Office connected therewith:

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